

control systems

1.	Introduction: Concepts of system, open loop and closed loop systems, model classification; Mathematical modeling and representation of physical systems, analogous systems.	4
2.	Transfer Function Analysis: Transfer functions for different types of systems, block diagrams; Signal flow graphs and Mason's gain formula.	4
3.	Control System Components: Potentiometers, synchros, principles and applications of dc and ac servomotors, analysis and transfer function, servo amplifiers, modulators and demodulators, magnetic amplifiers; Position and speed control systems.	6

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4.	Time Domain Analysis: Time domain performance criterion, transient response of first order, second order and higher order systems; Steady state errors: static and dynamic error constants, system types, steady state errors for unity and non unity feedback systems, performance analysis for P, PI and PID controllers.	8
5.	Stability Analysis: Concept of stability by Routh stability criterion, root-loci and root contours, sensitivity analysis,	5
6.	Frequency Response Analysis: Polar and inverse polar plots, logarithmic plots, Bode plots, Nyquist stability criterion, gain and phase margins, relative stability, frequency response specifications, correlation with time domain M and N circles, Nichol's chart, closed loop frequency response from open loop response.	8
7.	Compensation Techniques: Compensation - lag, lead and lag-lead networks, design of compensation networks using time response and frequency response of the system; Feedback compensation using P, PI, PID controllers, ON-OFF control.	7

linear integrated circuits

1	Feedback Amplifiers: General feedback structure, properties of negative feedback, basic feedback topologies, determination of loop-gain, stability problem	6
2	IC OP-AMP Applications: OP-AMP fundamentals (Brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics), basic building blocks using OP-AMPS, inverting/non inverting VCVS, integrators, differentiators, CCVS, Instrumentation amplifiers, Biquad filter (LP, HP, BP and notch), Oscillators, A/ D & D/A convertors	6
3	Non-linear Amplifiers: Logarithmic amplifiers, Log/antilog modules, Precision rectifier, Peak detector, Sample and Hold circuits	10
4	Comparators and Timers: OP-AMP as comparator, Schmitt Trigger, Square and Triangular wave generator, mono stable and astable multi vibrator, IC timers and their applications. IC Analog multipliers: Basic circuits, applications	10
5	IC OTA Applications: Basic building blocks using OTA, electronically programmable functional circuit examples. Voltage regulators: (78/79, XX), 723 IC regulators (current limiting, current fold back), SMPS. Applications of analog switches: programmable gain amplifiers	10
Total		42

power transmission and distribution

1.	Transmission and Distribution Systems: Introduction, electrical supply system, comparison of AC and DC systems, overhead versus underground systems, choice of working voltages for transmission and distribution, transmission and distribution system architecture.	5
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2.	Overhead Transmission Lines: Mechanical design, line support, types of conductors; Overhead line insulators, types of insulators-pin, suspension and strain insulators, insulator materials, insulator string; Calculation of voltage distribution and string efficiency, methods of equalizing voltages, use of guard rings.	6
3.	Corona: Theory of corona formation, factors affecting corona, calculation of potential gradient, disruptive critical voltage and visual critical voltage, corona power loss, minimizing corona, merits and demerits of corona.	3
4.	Line Parameters: Line resistance, inductance and capacitance calculations, effect of earth on capacitance of overhead transmission lines, short and medium transmission lines, line performance and compensation.	8
5.	Underground Cables: Elements of a power cable, properties of the insulation and sheath materials, classification of power cables: belted, screened and pressure cables, dielectric stress in cable insulation, grading of cables: capacitance grading and inter-sheath grading, measuring capacitances and charging current in a cable.	6
6.	HVDC: Advantages and limitations of HVDC transmission over HVAC transmission, elementary ideas about converter and inverter operation, classification of HVDC links: mono-polar, bipolar and homopolar, economic comparison of HVDC and ac systems.	4
7.	Surge Performance and Protection: Switching surges, origin and mechanism of lightening strokes, direct and induced strokes, protection from surges- lightning arrestors (rod gap, horn gap, multi-gap and expulsion type) and surge diverters, evaluation of surge impedance, energy and power of a surge.	6
8.	Introduction to Traveling Waves: Introduction and mechanism of traveling waves, wave equation, characteristic impedance of a line, incident and reflected waves, transmission and refraction of waves, velocity of traveling waves, behavior of traveling waves for different terminations: inductor, capacitor, open-end, short-end and over the junction of dissimilar lines, attenuation of traveling waves.	4

electro magnetic field theory

1.	Mathematical Orientation: Over view of Electromagnetics, Electrostatics, Magnetostatics, Electromagnetic field, Maxwell's equations, wave equation and Electromagnetic wave propagation. Review of scalars, vectors, vector multiplication- dot and vector products, component of a vector, Co-ordinate system- Cartesian, cylindrical and spherical co-ordinate system. Transformation of different co-ordinate system, cylindrical to Cartesian, spherical to Cartesian, cylindrical to spherical and vice versa. Gradient, Curl and Divergence. Divergence theorem, Stroke's theorem. Line integrals, Surface integrals, Volume integrals. Significance of line integral, surface integral and volume integrals. Differential length, area and volume in Cartesian, cylindrical and spherical co-ordinate system. Dirac- Delta function.	6
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2.	Electrostatic Fields: Overview of electrostatic field, Coulomb's Law and field intensity. Electric fields due to point charge, continuous charge distributions like line charge, surface charge and volume charge distributions. Electric flux density, Gauss's Law. Application of Gauss's law - Point charge, Infinite line charge, Infinite sheet of charge and uniformly charged sphere. Electric potential, Relationship between E and V - Maxwell's equation. Scalar potential. Electric Dipole, Electric field intensity due to electric dipole. Electric flux lines. Properties of Electric flux lines- flux lines due to point charge and dipole. Energy density in Electrostatic field, Energy density. Classification, of materials based on conductivity-Conductors, Dielectric, Semi conductors. Convection and Conduction currents and current densities. Conductors, Point form of Ohm's law. Polarization in Dielectric. Effect of Polarization in Dielectric on flux density(D). Polar and Non-Polar Dielectric, linear, homogeneous, isotropic Dielectric. Dielectric constant and strength in Dielectric material, Continuity equation of current and Relaxation time. Electrostatic Boundary conditions - Dielectric- Dielectric, Conductor- Dielectric, Conductor-Free Space. Boundary value problems. Poisson's and Laplace's equations, Uniqueness Theorem. General procedure for solving Poisson's and Laplace's equations. Resistance and capacitance, Capacitance of parallel plate capacitor, coaxial cable, Spherical capacitor. The method of images used for finding V, E, D and r due to charges in the presence of conductors. Image theory- A point charge above a grounded conducting plane. Image theory- A line charge above a grounded conducting plane.	13
3.	Magnetostatic Fields : Introduction to magnetostatic fields, Biot-Savart's law. Numerical. Ampere's circuit law- Maxwell's equation. Application of Ampere' law - Infinite Line current, Infinite Sheet of current, Infinitely long co-axial Transmission line. Magnetic flux density. Maxwell's equation for static EM fields . Magnetic scalar and vector potentials. Biot- Savart's Law and Ampere's law. Forces due to magnetic fields - Force on a charged particle, Force on a current element and Force between two current elements. Magnetic Torque and Moment, Magnetic Dipole. Magnetization in materials- M vector, Classification of magnetic materials. Magnetic boundary conditions. Inductance for simple geometry. Magnetic energy, magnetic circuits. Statement and Interpretation of Maxwell's equation.	13

Power plant engineering

1.	Introduction: Conventional & Non-Conventional Sources of Energy and their availability in India, Different Types of Power Plants, Layout of Steam , Hydel , Diesel , MHD, Nuclear and Gas turbine power plants, Combined Power cycles – comparison and selection , Load duration Curves, Steam boilers and cycles – High pressure and Super Critical Boilers – Fluidized Bed Boilers	10
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2.	Thermal Power Plants: Basic thermodynamic cycles, various components of steam power plant-layout-pulverized coal burners-Fluidized bed combustion-coal handling systems-ash handling systems- Forced draft and induced draft fans- Boilers-feed pumps-super heater- regenerator-condenser- de-aerators, cooling towers, electrostatic precipitators	10
3.	Hydel Power Plant: Principle of working, Classification, Site selection; Different components & their functions; Types of Dams; Types, Characteristics & Selection of Hydro-Turbines; Mini & Micro Hydro Power Plants, Pumped Storage Power Plants	08
4.	Diesel And Gas Turbine Power Plant: Types of diesel plants, components, Selection of Engine type, applications. Gas turbine power plant- Fuels- Gas turbine material, open and closed cycles, reheating, Regeneration and intercooling, combines cycle	08
5.	Co-Generation: Concept; Schemes; Brief Description; Benefits & Limitations; Applications. Non-Conventional Energy Sources, Types, Brief Description, Advantages & Limitations	06

EE 208 Asynchronous and Synchronous Machines

1. Subject Code: **EE-208** Course Title: **Asynchronous and Synchronous Machines**
2. Contact Hours: L: 3 T: 0 P: 2
3. Examination Duration (Hrs.): Theory: 3 Practical: 0
4. Relative Weight: CWS: 15 PRS: 25 MTE: 20 ETE: 40
- PRE: 0
5. Credits: 4 6. Semester: **IV** 7. Subject Area: **DCC**
8. Pre-requisite: **EE-101/102, EE-201, EE-202, EE-205**
9. Objective: To familiarize the students with the construction and operation of asynchronous and synchronous machines in motoring and generating modes.
10. Details of Course:

Unit No.	Contents	Contact Hours
1.	Induction Machines: Classification and constructional features of wound rotor and squirrel cage induction machines, Rotating magnetic field, working principle, concept of slip, Equivalent circuit, determination of equivalent circuit parameters, derivation of speed torque characteristics; phasor diagram, Generator action, self-excited induction generators. Starting Methods of induction motor, Principle of speed control of induction motor, testing and efficiency Double-cage and deep-bar squirrel cage rotor induction motor; Space and time harmonics and their effect on motor performance. Single-phase induction motor: Single-phase induction motor working, double-revolving field theory, equivalent circuit, torque-speed characteristic, performance, testing and efficiency.	14
2.	Synchronous Generator: : Classification and constructional features of cylindrical rotor, and salient pole rotor synchronous machines, Armature reaction, Equivalent circuit, phasor diagrams, Voltage regulation, OCC and SCC characteristics, effect of variation of field excitation and prime mover input when synchronized with grid/infinite bus, V-curves and inverted V-curves of the alternator, Parallel operation of synchronous machines and load division.. Two-reaction theory for salient pole synchronous machines, phasor diagrams of salient pole machines, Power-angle equations of the cylindrical and salient pole rotor synchronous machines. Synchronous Motor: Starting methods, Effect of variation of field excitation when connected to grid/infinite bus, power factor control by synchronous motors, synchronous condensers, stability and hunting in the synchronous machine, Slip Test.	12
3.	Permanent Magnet Synchronous Machines: Working of PM-synchronous machines (PMSM) and PM-BLDC Machines, Methods of excitation of PMSM & PM-BLDC, Basic torque, EMF equations and their characteristics.	8
4.	Reluctance Machines: Working of Synchronous Reluctance machines and Switched Reluctance Machines, Methods of excitation, Basic torque, EMF equations and their characteristics.	8